

Peirick NOPP Report

Jefferson County

Data Collection Began: 2023
Data Collection Ended: 2024
Site Years: 2

Other Collaborators:

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Takeaways

- Economic optimum nitrogen rate (EONR) was 85 lb-N/ac in 2023 with relatively flat yield response to nitrogen.**
 - Corn yield at 0 N was 207 bu/ac.**
 - Low EONR and high yield at 0 N likely due to 2nd year alfalfa credit.**
- In 2024, EONR was reached at 154 lb-N/ac.**
- Greater post-harvest soil nitrate at highest N rate in both years, with especially high values in 2023 at N rates greater than EONR.**



Extension
UNIVERSITY OF WISCONSIN-MADISON

Nitrogen use efficiency for corn in the Rock River Basin

Overview

The Upper Rock River Basin is characterized by Silurian dolomitic bedrock, making it prone to groundwater pollution. The Dodge County Farmers Healthy Soil Healthy Water producer-led group aimed to reduce nutrient losses and improve farmer profitability by conducting on-farm nitrogen rate trials paired with extensive soil sampling. This report focuses on one of thirteen sites in the area conducting this trial.

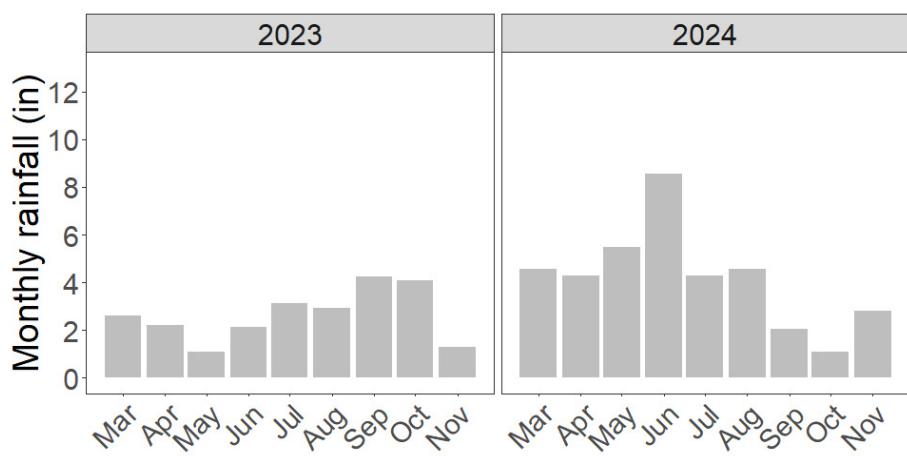


Figure 1. Monthly rainfall during the growing season in 2023 and 2024 with data from Watertown, WI. Data gathered from NOAA's National Centers for Environmental Information.

Table 1. Field history for 2023 and 2024.

Peirick	2023 South 40	2024 Marek 6
Soil series	St. Charles	Pella
Soil texture	Silt loam	Silt loam
Soil drainage class	Moderately well drained	Poorly drained
Years of previous 10 receiving manure	2	3
Years of previous 10 with cover crop	2	8
Years no-till	10	10
Irrigation	No	No
Drainage tile	No	Yes
Previous crop	Corn*	Corn

*Field was alfalfa in 2021.

Methods

Corn was planted green into a rye cover crop in both years. In 2023, fertilizer was applied at sidedress at rates of 0, 40, 80, 120, 160, and 200 lb N/ac. In 2024 fertilizer was applied at sidedress at rates of 50, 80, 120, 160, 200. Trial was a randomized complete block design with four replicates. Each year of the trial took place on a different field.

Data Collection

- Routine soil samples (0-6")
- Pre-sidedress soil nitrate samples (0-1' and 1-2')
- Post-harvest soil nitrate samples (0-1' and 1-2')
- Yield collected via yield monitor

Table 2. Trial management information for 2023 and 2024.

Peirick	2023 South 40	2024 Marek 6
Cover crop (CC)	Cereal rye	Cereal rye
CC seeding rate	35 lb/ac drilled	35 lb/ac drilled
Spring CC height	6"	6"
CC termination date	5/3/23	5/6/24
Manure application	None	None
Corn variety	Dairyland	Dairyland
Corn planting date	5/3/23	5/6/24
N application date	July	July
N application method	Coulter inject	Coulter inject

Spring soil results

Table 3. Routine soil analysis sampled at a depth of 0-6" prior to any nitrogen application. Routine soil sample not collected in 2024. Soil test interpretation categories for corn based on UW-Extension pub A2809.

Peirick	pH	OM	P	K	Ca	Mg
		%		----- ppm -----		
2023 - South 40	6.2	2.7	41	101	1887	528
Interpretation category			Excessively high	Optimum	High	High

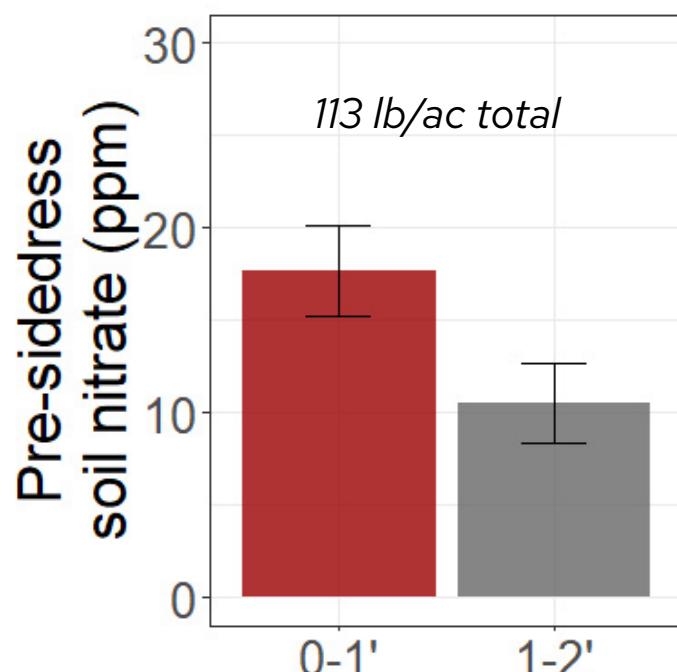


Figure 2. Pre-sidedress soil nitrate sampled prior to any nitrogen application in 2023. Spring soil nitrate not sampled in 2024.

- PSNT of 18 ppm indicates N contributions due to organic sources (2021 alfalfa crop).

Yield results

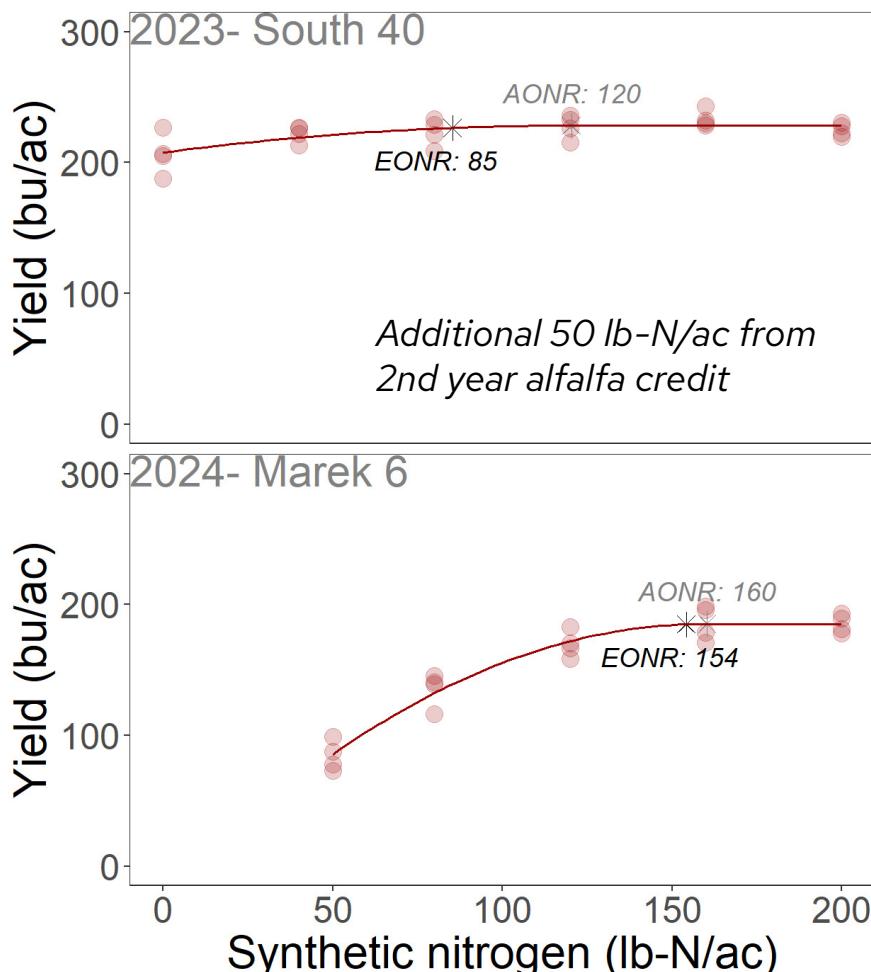


Figure 3. Corn yield (adjusted to 15.5% moisture) by applied synthetic nitrogen and field. Agronomic optimum nitrogen rate (AONR) is defined as the nitrogen rate that results in maximum yield, and economic optimum nitrogen rate (EONR) is the nitrogen rate that results in the maximum financial profit based on shape of yield response curve and nitrogen:corn price ratio of 0.1 (\$0.50/lb-N, \$5/bu corn).

- In 2023 EONR on the field was 85 lb-N/ac and AONR was 120 lb-N/ac.
 - 50 lb-N/ac additional N supplied from 2nd year alfalfa credit (UW-Extension pub A2809, Table 9.4)
- In 2024 EONR on the field was 154 lb-N/ac and AONR was 160 lb-N/ac.

Table 4. Yield and marginal net return by site and applied nitrogen. Values within **column and year** with the same letter are not significantly different according to Fisher's LSD test at alpha = 0.1.

- Significant difference in yield across nitrogen rates in 2023 & 2024.
- In 2023, no increase in yield beyond 120 lb-N/ac.
- In 2024, no increase in yield beyond 160 lb-N/ac.

Peirick	Applied synthetic nitrogen	Yield	Marginal net return*
	(lb-N/ac)	(bu/ac)	(\$/ac)
2023 South 40	0	207 c	1034
	40	222 b	1081
	80	223 b	1076
	120	228 ab	1078
	160	234 a	1088
	200	225 ab	1025
2024 Marek 6	50	84 d	397
	80	135 c	637
	120	170 b	788
	160	186 a	850
	200	186 a	828

*Marginal net return calculation based on nitrogen:corn price ratio of 0.1 (\$0.50/lb-N, \$5/bu corn).

Post-harvest soil results

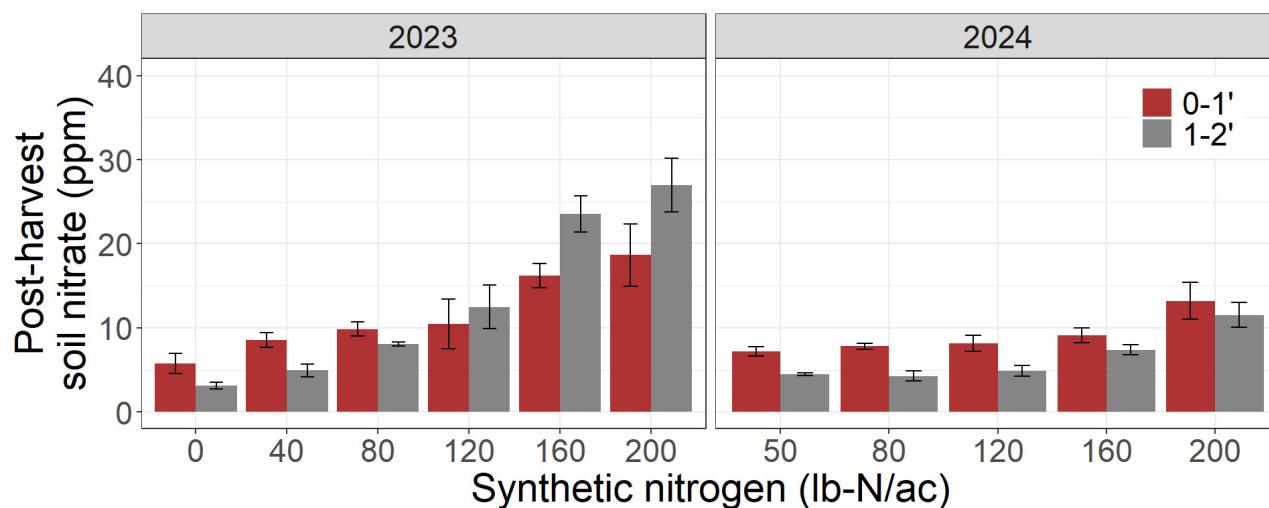


Figure 4. Post-harvest soil nitrate in ppm sampled at each nitrogen rate. In both years soil was sampled to a depth of 0-1' (red) and 1-2' (grey).

Post-harvest soil nitrate (lb-N/ac)

Synthetic nitrogen (lb-N/ac)	2023		2024	
	0-1'	1-2'	0-1'	1-2'
0	23 b	13 d		
40	34 b	20 cd	50	29 b
80	39 b	32 bc	80	31 b
120	42 b	50 b	120	33 b
160	65 b	94 a	160	37 b
200	75 a	108 a	200	53 a

Table 5. Post-harvest soil nitrate in lb-N/ac by year and depth. Values within column with the same letter are not significantly different according to Fisher's LSD test at alpha = 0.1.

- PHNT differed across N rate at both depths in both 2023 and 2024.

Conclusions

- In 2023, corn yield increased as nitrogen rate increased until it reached plateau at 120 lb-N/ac (AONR). Based on the curve of the yield response and a nitrogen:corn ratio of 0.1, EONR was 35 lb less at 85 lb-N/ac.
 - Yield response to nitrogen was relatively flat, indicating little need for additional nitrogen fertilizer. This response was predicted by high pre-sidedress soil nitrate. This nitrogen was likely supplied by the alfalfa stand on the field in 2021.
- In 2024, corn yield increased as nitrogen rate increased until it reached plateau at 160 lb-N/ac (AONR). EONR was only 6 lb less at 154 lb-N/ac.
- Post-harvest soil sampling indicated a difference in soil nitrate at both depths of the soil profile with greater soil N at the highest N rate in both years. This difference was greater in 2023, likely due to dry growing season and flatter response curve indicating more unused nitrogen at higher rates.
- Greater yields at AONR in 2023 (228 bu/ac) than 2024 (185 bu/ac).
- Yields above 5 year county average of 194 bu/ac in 2023 only.